The Hood Canal Dissolved Oxygen Program:
Relationship to Clean Water Act Mandates
as implemented by
the United States Environmental Protection Agency
and
Washington State Department of Ecology

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Background

The goal of the Hood Canal Dissolved Oxygen Program (HCDOP) is to determine the sources of low dissolved oxygen in Hood Canal and the effect on marine life. HCDOP will work with local, state, federal, and tribal government policy makers to evaluate potential corrective actions that will restore and maintain a level of dissolved oxygen that will reduce stress on marine life. HCDOP is a partnership of over 30 organizations that conducts monitoring, modeling, and analysis and develops potential corrective actions to address the low dissolved oxygen problem in Hood Canal.

HCDOP has two integrated and complementary arms: the Integrated Assessment and Modeling (IAM) study and the Corrective Action and Education (CAE) group. The CAE group focuses on preliminary assessment, corrective actions and demonstration projects that will help to improve levels of dissolved oxygen in Hood Canal. This group educates and involves residents in ways they can help improve the quality of water the Canal

The HCDOP IAM study is a three-year investigation using marine, freshwater and biota monitoring data and computer modeling to quantify the role the various natural processes and human actions are playing to control the concentrations of dissolved oxygen in Hood Canal and test corrective action scenarios. The study is described in detail at http://www.hoodcanal.washington.edu/.

The HCDOP IAM study is co-managed by the University of Washington Applied Physics Laboratory and the Hood Canal Salmon Enhancement Group. Its participants are comprised of state, federal, tribal, local, and university scientists and other contributors. .

Managers at U.S. EPA Region X (EPA) and the Department of Ecology (Ecology) desired clarification on whether the current study will be sufficient for them to carry out their mandates under the Clean Water Act, or if additional scientific work is needed. The purpose of this document is to provide that clarification.

What the Hood Canal Dissolved Oxygen Program Will Provide

The purpose for HCDOP IAM is to conduct a scientific study to understand the causes of low dissolved oxygen concentrations in Hood Canal and what corrective actions may help to improve conditions. This study is to be conducted within the context of the HCDOP, which has a diverse list of participants, including several state (Departments of Ecology, Fish and Wildlife, Health, and Natural Resources, Washington Sea Grant, Puget Sound Action Team), federal (EPA, Corps of Engineers, Fish and Wildlife Service, NOAA, PNNL, USGS, Navy), and local (Conservation Districts, Counties) agencies and academic interests (University of Washington Applied Physics Laboratory and the School of Oceanography) as well as the Hood Canal Salmon Enhancement Group, Hood Canal Coordinating Council and the Lower Hood Canal Watershed Implementation Council.

The study is designed to inform this broad array of management interests on the causes for the increased hypoxia situation and what potential corrective actions may be. The answers provided are intended to guide general management decisions for the diversity of agencies involved. The HCDOP Coordinating Group, composed of representatives from both IAM and CAE groups, will work to assess what corrective actions will be tested by working iteratively between the two groups. The study is not designed to answer specific management questions from particular organizations.

If a specific organization's question(s) can be addressed within the current scope of the HCDOP study, this will be done. However, if a specific management question could be answered by the HCDOP IAM modeling capability but is beyond the scope of effort for the HCDOP IAM study, additional funding to the HCDOP would be required.

What EPA and Ecology Need

In general, to carry out their mandate under the Clean Water Act, EPA and Ecology need to know whether the state's water quality standard for dissolved oxygen is being met in Hood Canal, and if not, what would be needed in terms of nitrogen load reductions to do so. Because the canal is at least partially affected by naturally-occurring low-dissolved-oxygen oceanic water, the answer to this question involves separating natural from human-caused effects. The approach that is usually taken:

1. Through modeling, define the natural nitrogen loading (best estimate) to Hood Canal and the associated dissolved oxygen concentrations (including spatial and temporal patterns).
2. Define the critical condition for assessing compliance with water quality standards. This includes both the critical place (i.e. latitude/longitude and depth) and date that is equivalent to a reasonable worst-case condition (i.e., conditions would be worse than this about ten percent of the time).
3. Define the additional loads from anthropogenic sources and their respective effect on dissolved oxygen levels, at the critical condition (place and time).
4. Determine whether current and/or future projected anthropogenic loads cause more than a 0.2 mg/L decrease in dissolved oxygen, compared to natural conditions for the critical condition. If so, identify the most reasonable management approaches for reducing anthropogenic sources so that water quality standards are met.

EPA and Ecology also have certain state and federally-mandated requirements related to data quality as well as the need to have highly defensible products that stand up to scientific and legal challenges. These requirements include:

- Water quality data used for management purposes must be collected under a Quality Assurance Project Plan.
- To withstand scientific and legal scrutiny, the final study results need to have documentation of model performance and uncertainty. The typical process is to first produce a "Model Development and Calibration Report" which is peer-reviewed by the participating organizations (the major elements of such a report are shown in Attachment A). Once the major comments are addressed, the model is used to assess compliance with standards and for running various management scenarios. Upon the completion of this phase, a "Model Application Report" (Attachment A) is prepared, which also undergoes a peer review.
- The model is made available for third-party use for running additional scenarios.

Sufficiency of the Hood Canal Dissolved Oxygen Program for meeting EPA and Ecology Clean Water Act Mandates

The Hood Canal Dissolved Oxygen IAM study will provide information valuable to EPA and Ecology. The information to be provided on the major factors and processes contributing to low dissolved oxygen is of major interest to these agencies.

In order to satisfy requirements for a QAPP so that data produced by HCDOP IAM could be used in any subsequent TMDL or CWA mandates, the HCDOP IAM study funded Ecology to develop a QAPP for Year 1 of the HCDOP IAM study (http://www.ecy.wa.gov/biblio/0503114.html). A Year 2 QAPP is in preparation.

The HCDOP IAM study will deliver information to the HCDOP Coordinating Group and the funding agent and sponsor of the study (U.S. Navy, NAVSEA, and Congressman Dicks) regarding the causes of low dissolved oxygen concentrations in Hood Canal and what corrective actions may help to improve conditions. Quarterly Reports are filed with these federal sponsors and are currently available on the HCDOP IAM website (http://www.hoodcanal.washington.edu/news-docs/publications.jsp). A final report detailing conclusions will be produced following the end of Year 3.

Documentation will be in the form of papers to be submitted to peer-reviewed scientific journals, and all relevant information will be presented therein. The only major difference from the Ecology documents will be that it will not be divided into "pre" and "post-study" documents. Rather the whole study will be described in a single paper, or a series of papers each dealing with a specific subject matter. There may be minor differences, such as consulting with "policy team" etc.

The models used for marine hydrodynamics and watershed processes are public domain models residing at the University of Washington. The codes are non-proprietary and open for review by other parties. Third-party use of the model will be welcome. There will however be an expectation that the interested party will work with the UW modelers (as a matter of collegiality)

and give credit to the effort that went into the implementation of the model in any publication or presentation that would come out of their use. For marine, the model, ROMS, is public domain, but each user needs to have a license for use of the model. We can give input data, grid, etc. For watershed, the model, DHSVM, may take additional resources to set up for a third party, or they may choose to use at UW for specific runs.

Assessment of critical condition would not be intentionally met by the HCDOP IAM modeling, but could be or could be partially with the existing model, given additional funding.

HCDOP IAM modelers would be available to run additional scenarios for Hood Canal beyond the scope of work in the study if clear expectations and working relations were defined and adequate funding was available.

Hood Canal is Unique

Because of Hood Canal's unique setting, the Clean Water Act mandates may be handled somewhat differently than the typical situation. In particular, the Hood Canal watershed is characterized by:

- Very few point sources that are regulated under the NPDES permitting system.
- The largest source of anthropogenic nitrogen loading may be on-site septic systems, which are regulated through the Washington State Department of Health and not Ecology.

Also it should be noted that the Hood Canal project is not currently being managed as a Total Maximum Daily Load project. The ultimate management approach for nitrogen loading reductions (if found to be needed) may be different than the typical TMDL approach. Nevertheless, the basic needs of EPA and Ecology would be as described above.

Attachment A. Typical Model Documentation Requirements

The Model Development and Calibration Report should include the following elements:

- Model selection, capabilities, software/hardware requirements
- Historic period(s) selected for model development & evaluation
- Available data and quality assurance evaluations
- Boundary condition setup (e.g., groundwater, weather, rivers to be included)
- Selection of critical model output locations and dates (in consultation with policy team)
- Hydrodynamic evaluation – simulated vs measured conditions
- Water quality evaluation – simulated vs measured conditions
- Evaluation of uncertainty
- Future monitoring recommendations to reduce uncertainty

The Model Application Report should include the following elements:

- Assessment questions
- Baseline assumptions and design conditions
- Model simulation results
- Conclusions about assessment questions

The recent work of Ecology and Portland State University on the Spokane River offers a good example of this type of documentation:

Model Development Report

Berger, et al. "Upper Spokane River Model: Model Calibration, 2001." January 2003

Berger, et al. "Review of Spokane River Model for Washington Department of Ecology". January 2004.

Model Application Report

Cusimano, R. "Spokane River and Lake Spokane (Long Lake) Pollutant Loading Asseessment for Protecting Dissolved Oxygen". February 2004.